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The MONTHLY REVIEW

Published by the

American Electro-Platers' Society

A SOCIETY FOR THE ADVANCEMENT
OF THE
SCIENCE OF ELECTROPLATING

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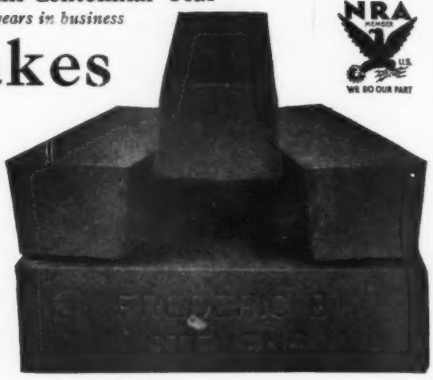

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MONTHLY REVIEW

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VOL. XX OCTOBER, 1933 No. 2

EDITORIAL

The Bureau of Education

We are indebted to Dr. Sanigar of Philadelphia and our own Bureau of Education under the direction of Mr. Thomas Slattery chairman, for the abstracts which are appearing recently in the Monthly Review. Both of these men are keenly interested in the welfare of our organization and we wish to thank them for their work which was first suggested to the society by Mr. Slattery at the Chicago Convention in his annual report.

The Bureau of Education has taken on a new lease of life in the last few years and would have shown still greater progress were it not for the slowing up of industry which has necessitated a curtailment of activities in nearly all our branches.

Under President George Gehling's administration classes in Chemistry, particularly relating to the analysis of solutions, were being held in all our branches with the result that the A. E. S. was going places and doing things. A few of these branches, for various good reasons were unable to continue last year and as a consequence the branch meetings were not as well attended as heretofore. Every branch should start now to include the Chemistry classes in their Fall and Winter program.

We wish to suggest that at the next meeting of every branch the secretary or any other member having a copy of the minutes of the Chicago Convention (1933) would bring this copy to the meeting and read and discuss all the items contained therein (Pages 12 to 17 inclusive) relative to the report of the program and Educational Committee.

Following the plans outlined it will be seen how much more interesting our meetings will be, since we can discuss such topics

as personnel, morale, shop management, handling men, employment, testing, training, welfare of men, wage incentives, etc.

Branches not having a copy of the minutes can secure one from Mr. H. A. Gilbertson, 434 S. Wabash Ave., Chicago for $3.00 plus mailing cost, or if requested we will publish the program in full in the next issue of the Review.

FARADAY — ELECTROPLATING IN HIS TIME AND TODAY

George B. Hogaboom

Read at the Chicago Convention 1933

Dr. Watts was reminiscent of twenty-one years ago when he attended the first banquet of Chicago Branch. I also can be reminiscent of nineteen years ago of presiding at your first convention held here in Chicago, really the first convention of the American Electro-Platers' Society. Nineteen years have passed since I have had that pleasure, and I consider it quite an honor to have the privilege of opening the session with the first talk.

In many respects the adage that "History repeats itself" can be applied to the electroplating industry. There is existant today the same desire for investigating the mysteries of the plating solution as there was a century ago. The fascination of putting an unattractive piece of metal into a solution, apply an unseen force, and have it apparently transformed into a more noble metal; or covered with one that imparts beauty to it is just as great today as it ever was. In the early days it was gold, the first metal that was electrodeposited, that awakened interest in the possibilities of an industry to which we today are dedicating another milestone of progress. Today it is chromium, the metal that has made the public electroplating conscious.

There has for years been an incessant demand for better plating. Improvement was hindered by the secrecy that surrounded the processes used. It was through the organization of the American Electro-Platers' Society that advancement has been made. While there has been in the electrodeposition of metals almost a "Century of Progress" it has been only within the last quarter century that there has been real progress and this has been through and with the conception and growth of the A. E. S.

In the "Century of Progress" of electroplating there is an interesting division of time. The first 15 years and the past 15 years

saw the greatest activity in the investigation and development of the art. From about 1840 to 1855 most of the solutions now used were brought into existence. A large number of scientists explored this new field and they made many valuable contributions. Several treatises and books were written. The Patent Offices of France and England were kept busy with applications—one was applied for by Dr. H. B. Leeson that "embraced almost every metal which could be deposited, and almost all the known solutions of their salts."

There were the inevitable controversies over priority of discovery and validity of patents. The discovery of the electrodeposition of copper, which developed into electrotyping was the first commercial application of the science to which Smee gave the name of Electro Metallurgy. This discovery was the subject of considerable controversy and it is apparent that Professor Jacobi, of Russia, Mr. Jordan and Mr. Spencer of England "viewed the subject of electrodeposition in the same light, and, according to their several abilities, presented to the public the same discovery, independent of each other, excepting the announcement made by one having hastened the publication of the observation of the others."

In 1842 Alfred Smee published his "Electro Metallurgy" and in it stated, "The laws regulating the reduction of all metals in different states were first given in this work as the result of my own discoveries." James Napier in his "Manual of Metallurgy," 1852, replied, "Unfortunately for the validity of Mr. Smee's claim, patents were taken out long previous, both in England and France, for the applications of the electrodepositions to the art."

Turning to the electroplating field the process of electro gilding and of silvering developed by the Elkingtons and Wright was assailed by M. de Ruolz of France. "For ten years or more war was waged not only in words but the law courts, and its echoes still rumble through masses of polemical literature and documents," wrote R. E. Leader in "The Early History of Electro Silver Plating." He continues with what probably will be said by those of our next generation in regard to present day discussions, "The story is long and complicated, and if it were worth while to tell in detail, a large volume would be required."

The repetition of history would not be complete unless an incident told by Mr. Reader is not quoted in view of the exper-

ience of many platers and manufacturers of today. A young German, in 1843, by his ingenuous charm of manner won the confidence of the Elkingtons. The result was that when he returned to Germany he left behind a thermo-electrical battery, three untried solutions and a specification for a patent. The solutions proved unsuccessful and when the books were balanced the Elkingtons had paid 1600 pounds sterling for what was of small commercial value.

I wonder whether we fully appreciate the value of the work done by scientists and laymen during those first 15 years? "They commenced when the art was young, when its practical applications were speculative, its advantages and disadvantages equally unknown, when difficulties of all kinds, such as beset every new art, had to be met, and considered and overcome. Where large operations in an extensive business were concerned, it was necessary to attend to details that some would have considered trifling, and to obstacles that others might have deemed insurmountable. Under the pressure of these circumstances all means were employed to procure information." (James Napier)

The source of current was primary batteries that required considerable attention. Rheostats, voltmeters and ammeters that to us are indispensable were not yet perfected. Many chemicals had to be manufactured by the plater. As late as 1855 Alfred Roseleur wrote, "I shall indicate to manufacturers the most simple processes for the preparation of the chemical products from which success or failure so often results." The amount of work done was prodigious and the results accomplished command our admiration. Many of the formulae for solutions have stood the test of years and upon them are based many of those used today. In many cases the modification of a formula has been due to the betterment in the quality of chemicals rather than upon the development of any new combination of ingredients.

One investigator, Alfred Roseleur, seems to have been one of the most painstaking as the results of his researches were freely copied by writers of plating books for several generations. Some authors gave their particular formula but when two or more formulae were given Roseleur's was almost certain to be the second one recommended. The reason of Roseleur's success is seen in the preface of his first book, 1855, "If conscientious and persevering work be sufficient to make a good book, this ought to

be excellent. Circumstances induced me, several years ago, to relinquish the study of pure science, and to devote myself entirely to the new industry of metallic deposits by the wet way. Being in constant relation with manufacturers, operators, and artists, I soon began to appreciate their wants, and to acknowledge with them how difficult it was to extract from too scientific and sometimes diffuse works, methods of operation which, being free from scientific theories, may present in a synoptical way all the series of operations conducting to a desired result. Therefore, upon the advice of a great number of persons, I have undertaken this book, which I claim to be conscientious, and true, since it does not contain any formula which I have not tried personally." Such an understanding of the problems of the men who were to do the actual production work, and such cooperation could not but bring about results that would stand the test of time.

Reading this and knowing of the work done in electroplating by some of the scientists of today is it not clear that history has repeated itself? What better proof is there that this is true than to refer to the work of the scientist, the careful and accurate investigator, our beloved friend, the man who honors the A.E.S. by presiding at this session, Dr. Oliver P. Watts, the man who made it hot for nickel solutions.

In England the Elkingtons and Wright had made so much progress in gold and silver plating, especially the latter, that by 1851 the "fused" or what we knew as "close" platers of Sheffield who vigorously opposed electroplating adopted the "wet" method so as to save their business. At the Great Exhibition of All Nations in London, 1851, the electroplaters took all but one of the honors and according to R.E.Leader this was lost "because one of the jurors came from a family who were filled with the traditions of 'fused' plating." Napier in commenting upon the electroplating exhibits at this World's Fair said, "The superb specimens of its (electroplating) products, which were displayed to the admiration of the world prove the immense importance of Electro Metallurgy and how much may yet be expected from one of the most ingenious of those modern applications of Science which subject the powers of Nature to the use and pleasure of civilized man. Arts and Sciences, like Kingdoms and Nations have their several periods of rise, prevalence, and decadence, and nothing can be more unstable than descriptions of an Art like Metallurgy — an art that must fluctuate with the course of

experimental discovery, that has rapidly attained a distinguished eminence, and that promises to extend its utility still farther over regions now unthought of." What vision and enthusiasm has been more fully justified? The prophesy was so true.

From about 1855 to about 15 years ago the art of electroplating fluctuated. There were several minor discoveries and of these only two stand out that can compare with the work done during the first 15 years. The perfection and commercialization of nickel plating by Dr. Isaac Adams and the development of the first dependable electroplating generator by Edward Weston at the request and financial encouragment of Abraham Van Winkle.

It is of interest to note two incidents in which history was again repeated. Wright, who discovered the value of potassium cyanide in electroplating, which discovery firmly established not only silver plating but the deposition of many metals from alkaline solutions, was a surgeon. Isaac Adams was educated as a surgeon and when he developed the electrodeposition of nickel from a double salt solution, like Wright, gave up the medical profession to become an electroplater.

The importance of Electro Metallurgy was brought out at the Great Exhibition in 1851, and the prophesy of Napier that much was to be expected was fulfilled by the exhibition at the Centennial Exposition, Philadelphia, Pennsylvania, in 1876 of the very heart of electroplating — The Weston Generator by The Hanson & Van Winkle Company.

Tomorrow we are to visit another Great Exhibition — A Century of Progress. Evidences of electro metallurgy will be seen on every hand. The literature that made this event known throughout the world was without doubt printed from plates made by the electrodeposition of copper--electrotyping. The money offered for admission will be mostly paper currency that was printed from plates that were made of electrodeposited nickel and copper, or of electrodeposited iron that was subsequently electroplated with chromium. One of the interesting exhibits is that of the assembling of an automobile, a product of the ingenuity of many engineers that has the stamp of the electroplaters art all over it. Many parts of the mechanism are plated with zinc or cadmium to give protection against corrosion. Some parts have been copper plated so that they could be hardened so as to withstand shock and wear. The pistons may have been electroplated with tin. The radiator, the bumper bars, the lamp

bodies, the door handles and body trim have been electroplated with copper, nickel and chromium, some parts having all three of these metals, one electroplated upon the other so that service as well as beauty could be yours. Going back further to the metals used, the zinc, cadmium, copper and nickel were recovered from their ores by electrodeposition. Without some of the electro-recovered metals it would not be possible to have the alloy steels that add so greatly to your safety. Take away those parts that owe their existence, either directly or indirectly, to the discovery and development of the electrodeposition of metals and we will have to return to the one-horse chaise.

In 1831 Faraday discovered electro-magnetic induction upon which depended the development of electric generators. The first commercial application of the current generated was for the electrodeposition of metals. This was the birth of the greatest and most useful servant the world has ever known — electro-dynamic power—the result of an electroplater endeavoring to do a better job.

One hundred years ago Faraday formulated the laws of electrolysis, laws that have been greater than those of the Medes and Persians for they have never had to be even modified to conform to any progress, however great, that has been made. To Faraday we owe the elements of plating nomenclature—electrolysis, electrodes, anions, cathions, anode, and cathode. Strange as it may seem these principles were given more than six years before Jacobi, Spencer or Jordan developed electrotyping or the Elkingtons and Wright discovered how to electroplate with gold and silver. Faraday's contact with electroplating was probably very slight. He pointed the way and gave laws and made discoveries without which electroplating may have been delayed several years. His work was the development of the phenomena relating to the application of electricity to chemical solutions.

The Centennial of Electroplating will be in 1939 if the work of the Elkingtons and Wright is to be commemorated. In their day the efforts of investigators, either the scientist or the layman, were applied to the composition of some solution from which a metal or a combination of metals could be electrodeposited upon some object for a useful purpose, such as an electrotype; of ornamentation such as gold, silver, copper or brass; or for lengthening the life of a corrodible metal by a coating of zinc. From the days of those pioneers until about 1918 the electroplating industry just

grew. Several scientists interested in electrochemistry made, from time to time, an investigation of some special problem and published the results. A number of electroplaters more inquisitive than many of their fellow craftsman developed some new solution, or method of operation. While all of this was of exceedingly great value and many will claim that better work was turned out in those days than there is today, it is evident that very little research of the nature carried on in other fields of electrochemistry was being done. Those who did research work devoted their efforts to a very few problems and many of these were of a general nature. Research in electroplating by a manufacturer was practically unknown. The electroplater was still talking in the same language as that of the pioneers. When the A. E. S. was organized in 1909 the idea of the control of plating solutions by analysis was not taken seriously. It is doubted if there was an ammeter on one out of every one hundred plating tanks, and that is a conservative ratio. When discussing the electrical control of plating solutions it was invariably in terms of volts. Still with all of this there was some excellent plating done and many platers were justly proud of the results they obtained.

When, however, in 1918 platers were called upon to meet definite specifications there was considerable confusion and some open rebellion. It is true that the specifications were drawn by those whose knowledge of electrodeposition was very limited and who thought that many of the principles that were accepted in the mechanical treatment of work could be applied to the electrocoating of metals in an aqueous solution. It is also true, however, that the plater himself and many electrochemists and chemical engineers could not intelligently point out where the specifications were incorrect, neither could they draw up satisfactory ones to meet the demands of the job. Copper was specified as a protective coating against corrosion. It was known that zinc gave a better protection but who was there that had sufficient definite knowledge as to the required amount of zinc to give protecton over a given length of time? Many of you can recall the requirements for a Black Nickel coating and the wonderful, or should I say woeful, composition of the plating solution.

That situation, in my opinion, and I think those here will agree with me, was one of the best things that has happened to the electroplating industry. It awakened an interest in electroplating

research. Fortunately the A. E. S. had been organized long enough to fully realize that the day of rule of thumb operations were drawing to a close and that they would soon be replaced by research and the inevitable control of the plating solution. The plater began to become familiar with new words, and even complicated equations took on a new meaning. Electrochemical terms became a part of his daily vocabulary. It seems but yesterday that the acidity of nickel solutions was determined by blue litmus paper, yet today hydrogen ion concentration--pH--is used as if litmus or congo red had never existed. It makes no difference whether the pH is expressed colorimetrically or to state that it was measured electrometrically with either the hydrogen or the quinhydrone electrode, the value is understood. Salt errors are allowed; and there is no confusion if a nickel solution is said to be run at pH 1.5 or 5.8.

While there is a keen interest in any new formula for a plating solution there is a greater interest in how the plating solution performs. Questions unheard of when the A. E. S. met in this city 19 years ago are being asked and intelligent answers are required. The plater wants to know can the solution be kept at a definite concentration by simple methods of analysis that can be made by one who is not a trained chemist? What is the anode, the cathode efficiency? Do the anodes corrode well or do they become polarized and what effect has electrode polarization upon the character of the deposit? Is the structure of the deposit dense or is it coarsely crystalline? What about the throwing power? More is being asked about anode and cathode overvoltage. It was thought that loosely adherent particles on the anode "floated" over and caused rough deposits, but it is now known that any metallic particles, even colloids, have the same polarity as that of the electrotrode upon which they are, and that they will be carried electrically from anode to cathode by what is given the term cataphoresis. It is understood that colloids at one concentration in solution will go to the anode, and at another to the cathode—we call them amphoteric—and it may be that "pitting" of nickel deposits is due more to that phenomenon than to the inclusion of hydrogen gas. The use of those terms is but one evidence of the advancement in electroplating. In the electrical and mechanical end a comparison of a belt driven plating generator of 1918 and the motor generator set of today with its synchronous motor; a comparison of the construction and efficiency of a rheostat; of a

still plating tank and a modern full automatic plating machine in which the volume of plating solutions are measured by the thousands of gallons, also show the progress that better quality plating and production has demanded.

Anodes have been improved so that not only can the plating solution be kept more uniform but so that the deposit also be made better. Nickel anodes of high purity, 99.7%, or better are demanded rather than those that contain a high percentage of carbon and iron. Cast copper with its coarse structure that meant blow holes and release of fine metallics that caused rough deposits is being replaced by rolled copper, either bars or discs, the latter assisting in maintaining a more uniform anode area and decreasing the amount of scrap. Brass anodes of definite copper-zinc ratio has solved the perplexing problem of always getting a deposit of the required color. Zinc anodes containing mercury, or aluminum and mercury so as to decrease the chemical attack of the acid or alkali of the plating solution and so that polarization and loss of metal through sludge can be decreased. Cadmium anodes of a special shape in cleverly constructed containers entirely eliminate scrap and permit a better control of the metal content of the plating solution.

With the methods of control, better anodes, the intelligent use of addition agents and a more comprehensive understanding of the fundamental principles that govern electrodeposition current densities unthought of before this era of research are being successfully used. Nickel has gone from a maximum of 5 amperes per sq. ft. in the double nickel salt solution of Adams to 20 amperes in the Watt's solution; to 50-60 amperes in the high acid or high metal solution; and Ballay, of France states that with the use of nitric acid, carefully controlled a current density of 100 amperes can be used. The addition of phenol-sulphonic acid to copper sulphate solutions permit the making of electrotypes at 100-150 amperes per sq. ft. and there is a very good probability of the success of higher current densities. Zinc, in the Tainton process, is deposited at 500 amperes per sq. ft. Willink reported in a paper read before the Philadelphia Branch, A. E. S., that he has successfully deposited chromium at a current density of 1000 amperes. Is it not timely to ask whether plating is not on the threshold of a new era?

Is this not emphasized when we read the papers that are now found in the literature? Pick up any magazine on chemistry or

metallurgy and it is certain to contain some article or reference to an electroplating process. This is not confined to this country or to the A. E. S. The Electroplaters' and Depositors' Technical Society in England is very progressive. The papers that are presented at their meetings are of the highest order. The subject of a paper is thoroughly discussed and with the frankness that brings out the strong points. Griffith told us about European practice of nickel plating and the quality of work done is comparable to that in this country. At the International Electrical Congress held in Paris last summer one session was devoted to the electrodeposition of metals; while, at times, we may think that in plating we are the leaders, it is at least significant that not one paper was presented by an American.

The very excellent work that has been done, and is being done, in the study of electroplated coatings by the research fellows of the A.E.S. with the unusually capable assistance of Dr. William Blum and his associates at the Bureau of Standards has been indicated in the solution of some of the problems investigated. The most outstanding result, so far reported, is that the rate and character of corrosion depend upon the locality where the failure took place. The St. Louis "Brown's" reported by Wm. Phillips, a few years ago, are a product of St. Louis and not of New York, Key West or Pittsburgh. Similar tests of electroplated coatings are being made in England and France. The data of H. Figour and P. Jacquet of France, recently published, shows that the same problem of corrosion confronts them and that they are seeking the solution along the same lines as we—ascertaining the weak points in electrodeposited coatings.

Interest in electroplating has become world wide. It is not being displaced despite the dire predictions that have been prevalent during the past few years. In fact, there seems to be a determined effort to improve electrodeposits. Research will point out where improvements can be made; and such research will not stop there, it will also develop methods by which better protection can be had against the ravishes of corrosion. The beauty of ornamentation will be increased. Gold, silver, nickel and chromium coatings have placed electroplating in the foremost ranks of an Art that adds to the appreciation of beauty. It always will be one of the most useful Arts. The prophesy of Napier in 1853 that it "promises to extend its utility still farther over re-

gions now unthought of" is even more true today than it was in his time.

The electrodeposition of the rare metals rhodium and palladium that a few years ago were impurities in nickel anodes; of tungsten irridium and tantalum; of alloys of two metals as iron-nickel, copper-nickel, silver cadmium, and even those alloys of three metals — cadmium-zinc-antimony, copper-zinc cadmium, and iron-copper-nickel that today are in the formative stage tomorrow may be common commercial practice.

We are entering upon a period when greater advancements will be made in the understanding of the workings of the plating solution. The day of hanging a piece of work in a solution and taking it out and stating that it is well electroplated is fast passing. Knowledge is being sought as to what actually takes place in the plating solution. The mere fact that the turning on of the current in a bath no matter how well constructed gives a metal coating is not sufficient. Where does the current go and what does it do to the solution? How can it be controlled so that it will deposit metal where it is wanted? What effect does the placement of work on racks have upon the distribution of the deposit? A complete control of every factor that enters into the plating operations must and will be known.

Today chemical control of plating solutions is an established practice. The future will bring its problems and the one that will demand our attention in the very near future is the distribution of current so that the deposited metal will be uniform in thickness over the entire article.

All this story of progress from the days of the pioneers in the middle of the past century to this gathering of the members of the American Electro-Platers' Society, the organization that, through the whole-hearted cooperation of its members, brought about the interest now being taken in research problems of electroplating, permits the repetition of the words of one of the foremost platers of a century ago because of their truth and "proves at once the importance of Electro Metallurgy and how much may yet be expected from one of the most ingenious of those modern applications of Science which subjects the power of nature to the use and pleasure of civilized man."

MICROSCOPIC MEASUREMENT OF COPPER AND NICKEL PLATE THICKNESS ON STEEL, BRASS AND ZINC DIE CASTINGS

By Fred Carl

Read at Chicago Convention 1933

Mr. Chairman, Members of the Electro-Platers' Society and Guests: Many of you, no doubt, heard the lecture given by Dr. Watts last year at the convention, and will remember something of the general nature of his talk. Encouraged by his success in the measuring of plate thickness on steel radiator shells, we decided to make a further investigation of the possibilities of this method.

Since the trend of modern industry calls for the standardization of plate thickness on each base metal, it was our purpose at the beginning of the investigation to develop a fairly rapid method for the measurement of plate thickness which could be applied as a control check on the thickness of the deposit. Heretofore the microscopic method of determining plate thickness has to a large degree, been considered of a research nature and not of sufficient speed to be classed as a control method. However, if this method as applied to copper and nickel plating could be placed in the routine or control type of work, certain advantages could be gained which would not be possible with the usual chemical method.

Especially was this desirable where there were three layers of plate, for example, Nickel - Copper - Nickel on Steel. In this instance a chemical analysis would be quite long and would require several separations, while if a rapid microscopic method were possible, this extra work could be eliminated, and the results would be obtainable in a reasonably short time.

As the investigation progressed, the methods used were extended to cover measurement of plate thickness on sheet Brass and Zinc Die Castings. This paper then naturally falls into a subdivision of three groups, as follows:

Copper and Nickel on Steel
Copper and Nickel on Brass
Copper and Nickel on Zinc Die Castings

COPPER AND NICKEL ON STEEL

In the case of plating on steel, the finished plated part (without the chrome plate) is first given a twenty to thirty minute

plating in a copper cyanide bath using as high a current density as possible without producing "whiskers" on the part. Then the part is plated in an acid copper bath for approximately an hour, again using as high a current density as is possible. This can be done in a production lineup and need not require the services of a laboratory man. This plating should produce sufficient thickness of copper to protect the edges of the nickel plating and prevent rounding during the subsequent polishing. A specimen is then sawed out of the plated part and is ready to be set in a holder. For this purpose, two brass rings about one inch in diameter and about 3/8 inches wide are used. The specimen is placed inside the two brass rings, one ring placed on top of the other, and molten solder is poured into the rings and around the specimen. After the solder is cool, the two rings are sawed apart and either ring can now be used for the examination.

The polishing of the specimen is the next step in the preparation. Practically any good method of grinding and polishing metallographic specimens can be used. However, the following method has been found quite successful and fairly rapid, the grinding and polishing requiring about ten to fifteen minutes:

1. Grind on No. 80 Alundum paper.
2. Grind on wheel covered with canvas and using Emery Flour as an abrasive, grinding first across the plating and then with the plating.
3. Polish on wheel covered with Kersey cloth using No. 1 Levigated Alumina as an abrasive, polishing first across the plating and then with the plating.
4. Finish polish on wheel covered with Vel-Chamois cloth using No. 3 Levigated Alumina as an abrasive. The final polishing should be, as in the case of the rough polishing, first across the plating and then with the plating.
   (The reason for always finishing with the plating rather than across it is to prevent smearing of the nickel into the copper.)
   The specimen, after being washed with water is now ready to be etched.

The etching of the specimen in the case of plating on steel is divided into two classes, as follows:

1. Copper plating direct on Steel
2. Nickel plating direct on Steel

In the case where a copper plate has been applied direct to the steel, the etch used was the customary copper or brass etching reagent of the following composition:

N H_4OH - 6 parts
H_2O_2 (3%) - 1 part

However, where the nickel plate has been first applied to the steel, followed by alternate layers of copper and nickel, an etch must be used which will darken the steel yet not affect the nickel layers. The following composition was found to give good results for this purpose:

HNO_3 - 5%
Alcohol - 95% -by vol.

If more contrast is desired between the steel and the plating an etch of the following composition has been found satisfactory:

Glycerine - 3 parts
Conc HF - 2 parts
Conc HNO_3 - 1 part

This acid etch must then be followed by the H_2O_2 - NH_4OH etch in order to bring out the structure of the copper. In the case where the etching has been carried too far, either in the acid or the H_2O_2 - NH_4OH solution, the specimen must be re-polished beginning with the canvas covered wheel using Emery Flour as an abrasive. In most cases, overetching will be noticed as a broadening of the junction lines between the copper and nickel. This is caused by too prolonged etching with H_2O_2 - NH_4OH solution. However, where a definite distinction between acid and cyanide copper is desired, a slight overetching of the copper may have to to be resorted to in order to bring about the desired results.

COPPER AND NICKEL ON BRASS

The preparation of the specimen is essentially the same as in the case of plating on steel. However, due to the fact that the base metal is nearer the hardness of the solder used in the setting of the specimen, it is only necessary to apply a comparatively thin plate of external copper. Usually twenty to thirty minutes in a cyanide bath will give sufficient thickness to protect the edge and give contrast to the final nickel layer. The polishing of the specimen is the same as in the case of plating on steel, the time spent in polishing generally being somewhat shorter.

Since the base metal (brass) and the copper plating are both attacked by the usual NH_4OH - H_2O_2 solution, the etching of the specimen becomes quite simple. In the case of overetching, the polishing should be repeated beginning with the canvas wheel and Emery Flour abrasive.

COPPER AND NICKEL ON ZINC DIE CASTINGS

The preparation for examination of this type of plated work is similar to that of plating on brass. Only a comparatively thin plate of cyanide copper is necessary to protect the edges and give contrast to the final nickel plate. Twenty to thirty minutes in a cyanide copper bath should give a sufficient layer of copper for this purpose. The polishing of the specimen is the same as was given under plating on steel.

The greatest difficulty in the examination of copper and nickel plating on Zinc Die Castings has been in the etching of the specimen. The usual NH_4OH - H_2O_2 solution applied with a cotton swab, as in the etching of plating on steel and brass, attacks the Zinc base metal very rapidly and blurs the boundaries between the copper and the Zinc base metal to the extent that an examination is practically impossible. Visual examination in the unetched condition was found fairly satisfactory, the only difficulty being that plate boundaries were not distinct. Several electrolytic etches were tried with varying degrees of success, the greatest difficulty with this type of etching being in the pitting produced over the surface and especially in the boundaries. The most successful etch found was in a polish-attack method using the usual NH_4OH - H_2O_2 as the etching solution. With this type of etching, a small quantity of the etching solution is poured on the final polishing wheel and using a slight pressure, the polished specimen is held against the wheel until the base metal (Zinc) has darkened. This generally requires from three to five seconds for the etching. The specimen is then washed in water and alcohol and dried. Although this method sometimes requires repeated etching, the results obtained were superior to any other method.

CONCLUSION

Obviously there are disadvantages in this method of measuring plate thickness as well as advantages. First, it requires a metallurgical microscope with a range up to one thousand diameters,

and polishing equipment. However, a large number of concerns already maintain a metallurgical laboratory where such instruments would be available and no additional expense would be incurred. Second, it must be borne in mind that only a small part of the piece is actually measured. However, chemical analyses of plated parts when checked against the microscopic method seldom vary over .0001″ when the total thickness exceeds .0010″. With decreasing amounts of plating the differences will be reduced to as low as .00002″. Careful selection of the location on the plated part from which the specimen is to be cut is also essential in obtaining an accurate measurement. For example, where the piece is small and has sharp edges, the plate thickness may vary considerably from one spot to another. In this case it is well to take at least two measurements, one of the maximum and one of the minimum thickness and to average the results.

One of the greatest advantages in a practical way is the fact that a differentiation between the copper layers is possible, and also in plating where two or more nickel layers are used, a rapid measurement of the individual layers is made possible. This gives the production plater an idea which tank is giving the most efficient performance and he is able to adjust his plating time accordingly.

Another advantage is the one so ably presented by Dr. Watts in the previously mentioned lecture. The quality of the preparation of the base metal can be easily determined and recommendations made to better the finished part. An examination of the quality of the buffing on the various plates is also possible.

It is not our intention to attempt to show that the microscopic method of determining plate thickness can be substituted for the chemical method, but merely to show that where speed is essential the microscopic method can be used to good advantage as a supplementary means.

I wish to express my thanks to D. A. Cotton, W. Castell, G. Cole, and A. Fletcher, all of the Process Department, Delco Remy Corporation, for their assistance during the investigation.

(*Slide*) This is the structure of cyanide copper. It is plated at about forty amperes per square foot. Notice the structure is more or less mixed up. The crystals are quite small.

(*Slide*) You will notice the structure of acid copper. This was plated at the same current density. Notice the structure

is very direct. That is the way the two coppers appear in our type of plating. You must realize that with the addition agent to the acid copper the structure will change, but we use no addition agent to our acid copper, so we can distinguish when comparing the two structures.

(*Slide*) This is a slide made of a steel plated part showing the cyanide copper, acid copper, and cyanide-copper and nickel. It shows the difference between the acid, the cyanide and the acid. The thickness of the copper is two and one-half thousandths and the nickel is four-tenths. The copper has been buffed but the nickel has not been buffed. Notice the difference in the roughness of the surfaces.

(*Slide*) That is the same specimen except on the unpolished surface. You will remember Dr. Watts showed very clearly in his lecture last year how if this were buffed you have your chromium next to the copper.

(*Slide*) That is a production type job again plating cyanide acid and nickel direct on the steel. You can see the cyanide has a different structure than the acid; it is easy to measure thickness in each case and tell the production man when his tank is giving the best performance. The total copper thickness is about one and one-tenth thousandths; the nickel layer is about one-thousandth. The nickel was supposedly buffed, but it is still a little rough. The plater evidently didn't do as good a job as he should have done.

(*Slide*) This is another type of plating where we add nickel, plate nickel, direct on the steel, then copper and then nickel again. In this case this is not done in production in our plant any more. We are using cyanide-copper and acid-copper instead of straight cyanide-copper. Notice the general structure of the cyanide-copper, when it has not been buffed, giving an uneven line. The nickel was supposed to have been buffed. That thickness is about one-thousandth and three-quarters. The copper is probably in the neighborhood of one-thousandth and one-quarter.

(*Slide*) This next slide shows again the plating of the nickel on steel using instead of cyanide-copper the acid-copper and the acid copper not being buffed. Neither is the nickel buffed. In that case the thickness is about three-thousandths.

(*Slide*) This next is a production job showing about the thickness we expect to hold. In other words, this is slightly over one-thousandth of an inch. Then your cyanide-copper

strike, the acid-copper and then the cyanide-copper again. In this case the copper layer has not been buffed. The nickel was buffed, but it is still a little bit rough, because if the copper had been buffed smooth the nickel would have been smoother.

(*Slide*) This is the same specimen you saw before except that the steel has not been polished. You can readily see if this were buffed you would have your chrome plating direct on your steel, which is not very good.

(*Slide*) This is another type of plated work that is the same type as before the nickel-copper and nickel, the copper in this case being buffed. On these specimens where the nickel is plated direct on the steel, it is etched first with nitric acid and alcohol, and then given the edge to bring up the etching.

(*Slide*) This is another of the same type. This was taken fairly close to an edge and the plater didn't do a very good job of buffing.

(*Slide*) This is another application of this same method. It shows the buffing through the copper on the edges. This is a poorly buffed corner showing all the copper and part of the nickel buffed off.

(*Slide*) This is a well-buffed corner. Of course, you can expect to buff some of your copper off. You can see he has sufficient there to give pretty good protection and still has the nickel there.

(*Slide*) This is going from steel to brass. In this case the nickel is applied direct to brass. I might say if you use a copper strike on your brass before you nickel plate it you can't detect, at least I can't, anything under five hundred thousandths. I have detected as low as five hundred thousandths, but nothing under that. In this case there was a copper stripping, but it doesn't show. This thickness is about eighteen hundred thousandths inches.

(*Slide*) This is the same specimen. At times when the thickness gets very low, we have to use one thousandth in order to get an accurate measurement. This is the same specimen. You remember in the other slide you could see that some of the crystals are identical. This checked with the five hundred.

(*Slide*) This is a little nickel plate. This is also interesting because of the fact that it was checked directly with the chemical method. I measured it with the thickness of ten thousandths and the chemical method shows twelve thousandths.

(*Slide*) This is one of the toughest jobs I told you about before,

the plating of copper and nickel on zinc die casting. It requires this polishing to bring it out. The thickness is about one and one-quarter thousandths, the copper and nickel being about even in thickness.

(*Slide*) This is the copper. This slide isn't very distinct. This is the cyanide copper here. You had to plate a cyanide copper first on the die cast; then came the acid copper and was partially buffed. It wasn't so well buffed. Then the nickel was buffed.

(*Slide*) You can see the same specimen taken where the current density was higher showing they have evidently taken it out of the bath once and were afraid they didn't have enough thickness, so they put it back in again and then the acid and nickel and in this case we did not plate the copper on the edge. We can see the chrome here on the edge.

(*Slide*) This is not a production job, but it could easily be one. Copper nickel-copper-nickel. That total thickness is about two thousandths.

(*Slide*) Here is another interesting application of the same method showing a die cast blister. We were having a lot of trouble with blisters at the plant and we were asked to determine what was the cause of all the blisters. We don't claim that we can tell you right off hand what causes blisters. In this case we sawed down to a blister and set it in the solder, and polished right down into the blister, and found the plating was adhering to the die cast. The die cast contained gas which when the plating was buffed the gas expanded and made a blister, so that the plating wasn't to blame at all. We came, of course, back on the die cast people to give us better die casting.

(*Slide*) Here is one of the old stories that is diffusion. This particular specimen was heated 450 degrees for about a week. It was simply a copper plating about one-half thousandth inches of copper originally on the die cast. Then it was heated for a week at 450 degrees. You can see here that we actually got a diffusion layer of, I should say, one and one-half thousandths at the very least.

(*Slide*) This was a sample of a die casting, one of our test specimens, that had been out on the roof for about a year. We originally had between fifteen hundred thousandths and two tenth thousandths of copper and about twenty-five hundred thousandth of nickel. It shows a dark zone under the copper which in the

next slide we see is actually a diffusion zone, but very little of the copper has diffused. I don't claim to explain the theory why no more of the copper has disappeared.

(*Slide*) This is the same specimen unetched. This shows the nickel, then the copper and then the thin layer which we call the diffusion layer. It may or may not be.

(*Slide*) This is the last specimen. We were having quite an argument at the plant whether the peeling is caused between the copper and the diffusion layer or between the diffusion layer and the die cast. So we took one nickel copper die cast, heated it for about a week at 450 degrees and peeled off the plating wherever it wanted to peel. We found the peeling occurred between the diffusion layer and the die cast and not between the copper and the diffusion layer. It was quite interesting.

CHAIRMAN BLUM: This certainly is a very interesting and fascinating presentation, with beautiful, striking illustrations of the possibility of microscopic examination. We would like to have some discussion of this paper.

MR. HAROLD W. FAINT: I was interested in that blistered specimen inasmuch as I saw the same thing the day before I came to the convention. I would like to ask, did that blister occur some period of time after the plating was put on?

MR. CARL: No, as I remember, it occurred shortly after the plating was put on.

MR. FAINT: The blister we ran across didn't show up until twenty-four hours after the plating was put on.

MR. CARL: It may have been twenty-four hours after. It wasn't any longer than that.

FROM THE FLOOR: On the same question of aluminum die casting, the question arose as to poor cleaning. I experienced a case in which we took all the possible pains we could with organic solvents and polishing pieces and so forth and still these blisters came forth. When we got down to looking at it, it seemed that actually the blistering was due to the acid and the under pressure in the die casting metal. Then in your intermediate polishing operations with your heating, even though care is taken, aluminum is a good conductor of heat, and you have expansion and letting loose of your basic metal from the plate. One way of eliminating that, we found helpful, was after preliminary polishing we took these castings and put them in an oven and baked them for

approximately an hour at 400-450 degrees. Then we found an undulated surface on the metal where these little gas pockets rose up. We stuck them in the sand blast and went ahead and performed our other polishing and grinding and polishing operations on it. Then we went ahead and plated; we had a few little holes but elinimated the blisters. Sometimes the holes aren't as objectionable as the blisters.

CHAIRMAN BLUM: Is there further discussion of this paper?

I might point out this question that has often been a matter of concern in connection with specifications as to what method of test should be used. I think, as Mr. Carl pointed out, you can not expect to take the place of a stripping method by a microscopic examination. Each tells you something and neither the whole story. The stripping method tells you the average thickness and the microscopic examination is necessary if you are going to tell the thickness at a particular point. The difficulty with a microscopic examination is to incorporate it in a specification, because then you have to specify the point where your test must be made, otherwise you might make your test in such a way as to appear either favorable or unfavorable. You can use one illustration: The federal specification for silverware provides a certain average thickness of silver that is provided by a stripping method. Then on the bowl of the teaspoon it shall be not less than a certain thickness, so we take the point of the greatest wear and use the microscope. I use that to show how both methods would be useful and certainly what has been shown here illustrated the value of this method in a plant where you have a chance to check up on your production methods.

Is there further discussion?

MR. NIXON: On the general subject of measuring the plate, we have for some time been measuring plate thickness by a ten thousandths micrometer, peeling the specimens by any one of several well known methods for getting separations on steel; for example, using gravity rubbing or by chromide or something of that nature. For work in our own plant we find that very quick, and it has the advantage of giving us a great many readings in a short time. The error, I don't think, is very large, but, of course, there is some there. That is more or less offset by the very many readings that you take in a short time. I am wondering whether anyone else has tried a similar method and has any comments to make.

MR. CARL: That would give you the total thickness quickly easily, but it wouldn't give you the individual layers. If you had nickel-copper-nickel you couldn't detect the nickel-copper and then the nickel.

MR. NIXON: It is no substitute for the microscopic analysis of the plate, but for routine check-up on your thickness it has possibilities.

CHAIRMAN BLUM: Is there further discussion?

MR. PHILLIPS: I think if we would use those methods of peeling coating more we would get a better idea of distribution. It tells you that very nicely. It is pretty hard to get it in any other way as quickly. Nixon says there is some little inaccuracy, but it tells you very quickly just the way your plate goes on and if you want to get various plates you can do them at one time.

MR. HOGABOOM: I would like to point out some of the differences in the studies such as were given here which were exceedingly interesting and of great value and indicate another point that was stated that we know chemistry of plating solutions. But the next thing is distribution of current and such deposits. In the study of the work in England they are going, I believe, a little step farther than what was shown in these pictures. That is to find the effect of the bond of the deposit. On a base metal the value of that deposit depends in a large measure upon how well it adheres to the base metal. In the second illustration it is clearly shown that the article has been buffed and then there has been a skin effect from buffing and then the acid copper put across that, because the construction of the acid copper is apparent; whereas in the work that we know that has been done where that skin has been removed, the structure of the deposit has followed the deposit of the base metal. That is important.

In England they are recognizing that to a marked degree. You probably recall the work, the paper, by Hottersall that was presented this past winter at the English Electro-Platers' Society where he was determining both microscopically and from an adhesion standpoint the quality of the deposit. He took a piece of brass and buffed it and nickel plated it. Then he drove a wedge in between the nickel and the brass and tried to strip the nickel from the brass. Instead of getting a complete separation that surface of the brass from the buffing ahdered to the nickel and separated from the crystal structure of the base metal. So in the case that was done here the base metal has not been treated

so that that morphious skin caused by buffing is not removed, and it does not need to destroy the luster. You do not get a perfect bond; and that bond will affect the life of the article in service, as proved by Hottersall. I would recommend that that paper be read to show that English platers are studying the same as we, but from a different angle. By bringing the two together the results will probably be much better.

CHAIRMAN BLUM: We will get a good adhesion between the two countries.

MR. A. G. SPENCER: There is one thing I don't think Mr. Carl has covered in his slides. It is possibly due to the good plating conditions that they have at Delco-Remy. That is the following up of shooting trouble in the way of cleaning and dirt particles. Possibly he may have some slides or some photomicrographs of failed plates. I think he could show up very clearly by examination under the microscope whether he is having trouble in cleaning, in removing, all the grease from the piece by taking a cross section of the plate at some failed part. In a great many cases he will find the original grease or cavity or what have you under the plate. The plate has just bridged over it and is non-adherent. In other cases where you may have a particle of abrasive or steel, still adhering to the base metal the plate will build up higher at that particular point and actually will magnify the article there. It is a very interesting study of the micrology of plating to get at it under the microscope.

MR. CARL: I did run into that one thing once when we were having trouble with the plating not adhering and I found by examination that there were gaps. In this case it was nickel - copper - nickel on steel. While I found no grease, I found the gaps between the first nickel and steel and we found it was in our cleaning process. I don't have that made up into a slide and don't have it with me, but we did find it once.

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A CENTURY OF PROGRESS IN NICKEL DEPOSITION

W. M. Phillips

Read at Chicago Convention, 1933

I first want to say that the material available for this paper was not quite as extensive as I had at first hoped. I find that the development of nickel plating really started in 1860. If you will bear with me I will read this paper and then I have a few slides, and I hope there will be a few questions.

There were platers before this century of progress in nickel plating. A Greek historian by the name of Zosimus mentions them. I do not believe these men were members of our society, since this goes back to the fifth century. The most cherished possessions of these war-like platers were their swords and shields and they copper plated them by dipping in a suitable solution. History is unfortunately vague as to the cleaning method used, or even as to bath composition.

Now later on, in fact much later, is another mention of platers. This time one Mr. Paracelsus in the sixteenth century describes the transmutation of iron to copper. The way this seemed to have happened was that someone dropped some iron into the blue river Schmöllnitz located in Hungary. The results were quite astonishing and as I have indicated before quite misunderstood. However, this is merely a question of degree of misunderstanding as even in this enlightened century we are still quite puzzled as to why and how some things happen.

Now as to the progress of nickel plating — when did it start? I should say without fear of contradiction that nickel plating is a development of this century. It is true that like other developments there were many people who contributed to its possibility and success. Our good friend Mr. George Hogaboom has very interestingly told of Mr. Faraday's great contribution. Those among others of the very early workers who have made nickel plating possible are Volta, Galvani, Benjamin Franklin and many others.

To illustrate the fact that plating of any kind which might possibly be called commercial was a development roughly of the last 100 years, I will quote from the revised edition of Alexander Watt in which he says, "The earliest application of galvanic action to a useful and ornamental purpose that I am acquainted with was practiced by Mr. Harry Bessemer of Baxter House Camden Town who about ten years ago (or 1832) employed galvanic apparatus

to deposit a coating of copper on lead castings." The specimens I have seen are antique heads in relief, the whole occupying a space of 3" by 4". Nickel plating was not done successfully until many years after copper plating had been well established. I have not been able to establish the exact date of its inception, but it seems that it must have been early in the 1860's that a solution was made with double nickel salts by a Mr. Boettger. In 1869 appeared a patent under the name of Mr. Isaac Adams, Jr., of Boston, Massachusetts.

Claim No. 1 of this patent reads: "The electrodeposition of nickel by means of a solution of the double sulphate of nickel and ammonia or a solution of the double chloride of nickel and ammonia prepared and used in such a manner as to be free from the presence of potash, soda, aluminia, lime or nitric acid, or from any acid or alkaline reaction."

Claim No. 2 said, "The use for the anode of a depositing cell of nickel combined with iron to prevent the copper and arsenic which may be present from being deposited with the nickel or from injuring the solution."

Strange to say, this patent was sustained in the extensive litigation which followed.

Adams, however, had merely complicated a simple thing. His complicated process was not needed very long and as time went on progress in nickel plating advanced steadily.

Typical of the formulas given and used at this time and for quite a number of years afterwards is one in Langbeins book, as follows: 8 parts by weight of pure nickel ammonium sulphate in 100 parts by weight of distilled water. Electromotive force at 10 ccm - electrode distance, 3 volts. The suggested amperes are less than 5 per square foot.

Now will you go with me into a plating shop of that time. For a cleaner potash solutions were most popular. The scrubbing brush was a necessity. The source of current was a battery, or, a little later, a generator of the self-excited type which might suddenly turn around and start to deplate. The tanks were generally of wood and often had a tendency to leak. Basements seemed to be preferred as locations for plating plants. Quoting from a well-known book written about that time, the author says, "Although we have taken 100 gallons as standard we may state that for large operations tanks capable of holding 250-300 gallons or even more are used. For working the 100 gallon bath four

cells of a three gallon Bunsen battery will be required."

In 1894 a process known as the Thum process was started at Newark in the plant of the Balback Company. Here they used cast anodes from the Orford Copper Company containing 95-96% of nickel and I regret to record that they reported success with a high pH nickel bath kept alkaline or neutral with ammonia.

Now since nickeling had a good start it proceeded with comparatively great rapidity. The following additions to the bath were made:

Boric Acid
Chlorides
Anodes of greater purity

The boric acid, I believe, was used before its function as a buffer was understood.

The use of chlorides made possible the use of anodes of greater purity. Next came the use of single nickel salts and the Watts solution and an understanding of the use of higher temperatures and current densities.

We are all familiar with Dr. Blum's work with us on the importance of pH values and their determination.

The conveyor tank put in its appearance and plating barrels were greatly improved.

One of the really great developments in the art of nickel plating took place largely within the last twenty years and that is the general use of chemical analysis for the control of nickel plating solutions. With this comes a better understanding of the whole subject both as to theory and practice.

Better cleaning methods and cleaners have contributed a great share to the advancement of the art. We are no longer satisfied with potash or the scrubbing brush and the brush is in particular disrepute.

We have been provided with much better nickel anodes and much better chemicals than were our predecessors.

In the past ten years a very large change has taken place. I refer to the use of greater thickness of nickel plate. It has been only a little more than ten years ago that examination of all the plating on a car showed an average thickness of nickel less than .0002. The specification for the nickel on this same car today calls for .0005 min. and a like amount of copper.

Chromium plate for decorative effect is merely nickel plate with a thin veneer of chromium on it. Good nickel plate has in my experience always been more a problem than chromium.

The need for greater thickness of nickel plate has increased the problems, or I should say magnified the problems already existing.

Pitting becomes more of a problem, roughness greater and the question of nickel distribution more troublesome. I should like to record that in the past three years I have seen great improvement in the facility in meeting these problems.

A better understanding has come about in the matter of the use of pH values making it easier to get thick deposits without increasing floor space or tank equipment. It was the good fortune of the organization by whom I am employed to be at least one of those to realize the value of the higher acidities, to increase the range of good nickel plating.

It may be a happy thing that there are still problems in this art. There are new discoveries to be made, greater economies and best of all still better quality to be produced.

One of the most important things that has happened is the exposure of 7000 panels of plated materials to find out just what will be required, not in the next century, but right now, and the comforting thought that whatever is required we will be able to come across and do it.

Now I have some slides which I should like to show you.

(*Slide*) This is the first battery that was used extensively. It is an old zinc plate type of battery.

(*Slide*) This is the next generator they had to deal with. It is what was known as Cox Thermopile. That one had a water jacket and a spirit lamp.

(*Slide*) You will notice that that generator was capable of producing all the way to four amperes. That is what they had to work with in those days.

(*Slide*) This is also a table showing what the larger outlet would produce. This Cox Thermopile was produced in England, but many of them were brought over to the United States. You will notice the price of it was something over six pounds, or somewhere around $30.00 for the smallest ones.

(*Slide*) There is one type of sulphic pitting generators that I did have the pleasure of working with. That thing would run along, as I said in the paper, very nicely for a little while and then you would lift up a peice of work and find it was deplated. You would trace your current through and find you were going backward. Then you had to get something to buck the field over the

other way. It was a common experience when you started up to have the current go the wrong way.

(*Slide*) That is just a little later machine in that it has two commutators. It was a one-horse power outfit which was enough to do the plating of the average shop at that time.

(*Slide*) Now we are getting into modern times and here is the single commutator type machine with which we are all familiar.

(*Slide*) There is a machine we are also all familiar with. I just want you to bear in mind, with all deference to the past, that that was a development of the little fellow which I showed you in the first slide.

(*Slide*) Here is a typical plating room of, we will say, fifty years ago. They show a few meters up there, but I am sure they were volt meters and not ammeters at that time.

(*Slide*) This shows a little more modern development in that we have a conveyor type of the ring around type with which we are all very familiar.

(*Slide*) This shows a more modern plating plant capable, I figure, of producing about one thousand times the amount shown in the first small plant.

CHAIRMAN BLUM: Are there any questions or is there any discussion of Mr. Phillips' interesting paper on the bird's-eye view of the history of plating?

MR. PHILLIPS: May I ask Mr. Hogaboom to say something about his experience with Dr. Adams?

MR. HOGABOOM: When the first banquet of the National Electro-Platers was held in 1909 or 1910, I wrote to Dr. Isaac Adams, of Boston, requesting that he give us a talk. I got a letter from his secretary stating the Doctor was sick and couldn't attend. Later when I went to work for a company in Waterbury the statistician there, recalling my name, asked if I wasn't the one who wrote to Dr. Adams when he was Dr. Adams' secretary. Dr. Adams died a few months after I had written to him. He told me that Dr. Adams was educated as a surgeon. He was sent to Phillips Academy, Exeter, New Hampshire, and then to Harvard University and became a graduate surgeon. He was interested in terrestrial magnetism and was a correspondent for the geodesic survey. He became interested in nickel plating so much so that he gave up the medical profession and devoted his whole time to nickel plating, incurred the displeasure of his father who disinherited him. He went to France, interested the French govern-

ment in nickel plating and they gave him a contract for plating their small arms. The discussion finished, he was to go the following day and sign the contracts when that night the Franco-Prussian War was declared. So Dr. Adams lost his job, but continued with nickel plating, and we owe a great deal to him.

I thought it would be of interest to know that he gave up his profession, was disinherited, just so that we would know something today about nickel plating.

ABSTRACT SECTION

EDWARD B. SANIGAR

These abstracts are mostly adapted, by permission, from "Chemical Abstracts", the references to that publication being given in the form — *C. A.*, **27,** 3402 (1933) *i. e.*, Chemical Abstracts Volume 27, page 3402 in the year 1933. The name appearing at the end of the abstract is that of the abstractor. Abbreviations for scientific journals are those used by "Chemical Abstracts" (see *C. A.* **25,** 6019 (1931).

E. B. S.

Plating on zinc and zinc-base die-castings. LESLIE WRIGHT and F. TAYLOR. *J. Electrodepositors' Tech. Soc.*, Preprint **8,** 19pp. (1933)—After a comprehensive historial survey, the authors give the results of investigations. A cleaning soln. containing 10g./l. sodium silicate and 30g./l. tri-sodium phosphate, operated at approx. the boiling point with just enough current to cause the article (cathode) to gas freely, was found to be best, as cleaning could be done in 1/2-3 minutes without discoloration of the zinc. For pickling, immersion for 1/2-1 minute in a soln. of 8% hydrochloric acid was found best as this etched, but did not discolor, the zinc. The importance of efficient rinsing between cleaning, pickling and plating, the avoidance of delay between pickling and plating, and the use of solns. for the preparation and plating of zinc and its alloys only, are stressed. After varying the soln. composition and conditions of operation considerably, the authors conclude the following soln. is best for the direct nickel-plating of zinc; Nickel sulphate ($NiSO_4.7H_20$),75; Sodium sulphate ($Na_2SO_4.10H_2O$), 200; Ammonium chloride (NH_4C1), 12 and Boric acid (H_3BO_3), 10, grams per litre, operated at room temperature with a mixture of cast and rolled nickel anodes, at a pH of 60 ± 0.2 and an average cathode c.d. of 10 amp./sq. ft. The soln. is said to become alkaline on working, this necessitating daily additions of sulphuric acid. A short initial "strike", at 30 amp./sq. ft., was first used but was found unnecessary after the bath had been worked for some time. Consistently good deposits of ductile nickel, which polished easily, were obtained from the above soln. It is sug-

gested that the nickel deposit must be at least 0.00035 inch thick if it is to be serviceable. Tables and graphs of the conductivities of sodium, potassium, ammonium and nickel chlorides, and of nickel sulphate-sodium sulphate solns., as well as photographs of faulty nickel deposits, are given.

C. A., **27**, 2627 (1933). EDWARD B. SANIGAR

Nickel-plating zinc-base die-castings at high current density. N. R. LABAN. *J. Electrodepositors' Tech. Soc.*, **8**, Preprint 6, 8pp (1933)—Methods, which are in successful commercial use, for the preparation and the copper- and nickel-plating of zinc-base die-castings prior to chromium-plating, are discussed. The difficulties usually encountered in the successful plating of zinc die-castings are reviewed, and their elimination by the methods given is explained. One essential in the series of operations described is that the articles should pass in a perfectly dry state from the cleaner to the next process. Degreasing is, therefore, done in trichlorethylene vapor (without action on the zinc), and the articles are wiped with a dry cloth before being racked. The extremely thin surface film left by the degreasing process is removed by the subsequent 1/2-1 minute anodic etch (see following abstract) which must take place soon after the degreasing or stains appear on the zinc and produce blisters in the final chromium-plating operation. The articles are rinsed and then copper-plated, since the direct nickeling of anodically etched zinc is said not to give good results. A 1-minute copper-plate is given in a cyanide bath containing cuprous cyanide, 3.5; sodium cyanide, 5.0; sodium carbonate, 2.0 and sodium thiosulphate, 1/6, oz./gall. at 50 amp./sq. ft., with not less than 4.5 volt bath voltage at 65°C. Daily additions of sodium cyanide, and monthly removals of a portion of the soln. and remaking with fresh salts, are required to keep the bath working at high c. d. After being swilled, the articles are dipped in a potassium hydrogen tartrate soln. (essential to the success of the process) or left in it until ready for nickel-plating. The nickel-plating is done in the following soln.: Single Nickel Salts, 2.5. - 3.0 lb.; Sodium Chloride, 2 oz.; Boric Acid, 3 oz. per gall., under the following conditions: temperature, 60°C; pH, 5.2 - 5.8; voltage 6 - 8v. for 11-inch electrode distance, with depolarised nickel anodes and vigorous agitation. The failures likely to result from the use of ordinary cleaning methods are described, and the working and maintenance of the solns. used in the above process given in detail. (NOTE. This is the abstract of a British paper: therefore the quantities represent ounces per Imperial Gallon. To change to ounces per U.S. Gallon, divide oz./Imp. gall. by 1.2 E.B.S.)

C. A., **27**, 1829 (1933). EDWARD B. SANIGAR.

Mass production methods in depositing nickel at high current densities. N. R. LABAN. *J. Electrodepositors' Tech. Soc.*, **5**, 129 (1930)—A description of methods which, for many years, have proved highly satisfactory for the deposition of nickel, particularly when the nickel is to be used as a basis for chromium. An electrolytic alkaline cleaner is followed by an anodic acid cleaner (concentrated sulfuric acid containing 3 oz./Brit. gall. potassium dichromate: specific gravity 50 - 55° Bé: original c.d. 100 amp./ sq. ft. which falls during cleaning), which cleaner is stated to have proved very satisfactory

for most steel articles (which become passive during the treatment) but usually unsuitable for brass because of deep etching, and to be a complete guarantee against stripping of the nickel deposit during chromium-plating, the nickel-steel junction being stronger than mild steel. The steel surface from the anodic cleaner has a dull, satiny surface which provides perfect "keying" for the nickel but does not interfere with the subsequent polishing of the deposit. It is pointed out that such a cleaner should not be used on all work indescriminately, and that good rinsing after cleaning is essential. Various correlated conditions of temperature, bath composition, pH,c.d., filtration, cathode movement, &c., to produce good nickel deposits are outlined, and the importance of good connections for high c.d.s. is emphasized. (See following abstract).

C. A., **24**, 3444 (1930). EDWARD B. SANIGAR.

Problems in high current density nickel and chromium deposition. N. R. LABAN. *J. Electrodepositors' Tech. Soc.* **6**, 159 (1931).—Certain aspects of the usual method of chromium deposition over a nickel undercoat, and particularly when the nickel is deposited at a c. d. greater than 50 amp./sq. ft., are discussed. For the best results the nickel undercoat should have perfect adhesion to the basis metal, be free from growths and from brittleness, and be non-porous and ductile. For composite nickel-copper-nickel deposits, anodic etching (see previous abstract) of the nickel before copper deposition is advised. For brass, in general, a bright dip (for etching), followed by a dip in 10% sulfuric acid (to remove oxide films), is recommended. The problems peculiar to nickel-plating at high c. d. are discussed under the divisions: (1) inclusion of foreign matter in the deposit, due to the vigorous agitation necessary, (2) the difficulty of securing adequate deposits on recessed surfaces, due to low throwing power, and (3) variations in the thickness of deposit due to contact resistance, to excessive c. d. at the bottom of articles, and to screening effects. Agitation by compressed air can be reduced if a moving cathode is used. Insufficient agitation leads to pitting and to rough deposits from light particles settling on the work, whereas too vigorous agitation stirs up heavy particles, which may be included in the deposit causing roughness. The use of depolarised anodes also decreases inclusions. Uneven throwing power, as evidenced by unequal thickness of deposit on the same article, and possible practical means of obtaining more even distribution of deposits are discussed. Data showing variation in thickness of deposit with variation in conditions of deposition are given, together with observed changes in commercial nickel-plating baths with time. The "mopping" of nickel deposits on an etched basis metal requires special attention, since it is necessary to cause the flowing action of the metal under the mop to penetrate to a greater depth to clear the etch pattern. Great pressure and a composition containing a high percentage of lime are required, while the nickel should be at least 0.0005 inch thick. A brief summary of the problems presented in the chromium-plating of the nickel undercoat completes the paper. Excellent dull deposits that are comparatively soft and that mop readily can be obtained from chromium-plating solns. Such deposits have high corrosion resistance, partly due to the flowing of the metal during the polishing process.

C. A., **25**, 3248 (1931). EDWARD B. SANIGAR.

Nickel-plating of zinc sheet. J. HAUSEN. *Oberflaechentechnik* **10,** 55(1933)—Improving rolled and cast zinc by nickel-plating finds ever-increasing application. Preparation of the surface is of special importance. The plating usually applied is nickel. The zinc is first cleaned anodically for 1/2 -3 minutes in a hot soln. of 6oz./gall tri-sodium phosphate with a c d. high enough to produce strong gassing. The surface is then made rough by pickling in a 1% hydrofluoric acid or 5-10% hydrochloric acid for about 1 minute. Several good formulas are given for use at room temperature and c. d. of 11-17amp./sq. ft. A nickel plate thickness of 0.0003 inch is quite sufficient if another metal is to be deposited on top of the nickel. For thicker deposits the rapid plating process is recommended in a bath of 15-18oz./gall. nickel sulfate, 3oz./gall. ammonium chloride, 2oz./gall. boric acid and 15oz./gall. anhydrous sodium sulfate: pH should be 5.5 - 5.9 at 24 - 30°C, and the c. d. 22 - 37 amp./sq. ft. The minimum thickness of 0.0003 inch is obtained in 10 minutes. The throwing power of the bath is good. Subsequent treatments for further working of the articles are briefly described.

C. A., **27,** 2385 (1933). M. HARTENHEIM.

Nickel-plating of fabricated zinc in z barrel. ALBERT HIRSCH. *Trans. Electrochem. Soc.*, **63,** 5pp(preprint) (1933)—Copper-plating upon a ball-burnished zinc surface results in blistering of the copper deposit due, possibly, to a highly mechanically strained film of metal produced by the burnisher. Nickel-plating directly on a roughened zinc surface does not yield that bright metallic lustre after ball-burnishing which is obtainable by nickel-plating a ball-burnished copper surface. However, roughening the surface of the zinc, copper-plating, ball-burnishing the copper deposit, nickel-plating and ball-burnishing the final nickel deposit gives a reproducible finish. The articles, after cleaning and rinsing, are barrel-plated in a copper cyanide soln. containing 3oz./gall. copper cyanide and 4.5oz./gall. sodium cyanide for 30 minutes at 140-170°F. at an approx. c. d. of 4amp./sq.ft., using 12 volts. The copper deposit is approx. 0.2oz./sq. ft., thick enough to prevent entire diffusion of the copper into the zinc. The nickel-plating is done in a barrel using the following soln.: Nickel Sulfate($NiSO_4.7H_2O$), 14-28; Nickel Chloride ($NiCl_2.6H_2O$), 3-6; Boric Acid (H_3BO_3), 2; Sodium Perborate($NaBO_3.4H_2O$), 0.1; and Ammonium Hydroxide(NH_4OH), 4.5 - 9.0 oz./gall., the ammonia being added until a pH = 7.6 - 8.0 (determined colorimetrically) is obtained. The nickel-plating is continued for 1 hour, using 6 - 12 volts and a c.d. of approx. 4amp./sq. ft. at a temperature of 90 - 140°F., giving a nickel deposit approx. equal to 0.36oz./sq.ft. Rolled annealed, 99+, "depolarised" nickel anodes are used and have given no difficulties.

EDWARD B. SANIGAR.

Deposition of copper on aluminum. H. GINSBERG. *Aluminum* **14,** 4-5(1932)—The metal is cleaned with 10% sodium hydroxide (NaOH) saturated with sodium chloride, washed, dipped in 2% hydrochloric acid, coated anodically (186 - 232amp./sq. ft. at 50 - 60 volt with electrode spacing 2.5 inch. for 10 seconds to 2 minutes in a 10% soln. of formic acid in water), washed, treated with sodium carbonate and sodium bicarbonate (3 and 6 oz./

gall. respectively) at 90 - 95°C. during 10 - 20 seconds and then coated with copper from a neutral copper sulfate or copper cyanide bath.

C. A., **27**, 3883 (1933). Brit. Chem. Abstracts.

Insuring clean cadmium-plated coatings. E. E. HALLS. *Synthetic and Applied Finishes* **4**, No. 37, 16(1933)—Satisfactory cadmium deposits are assured when attention is given to operating conditions as well as to initial cleansing and final thorough washing of the work. The use of iron, stoneware or rubber-lined wood for vat construction, and raw material of controlled purity with periodic filtration of the electrolyte, assist in preventing contamination. Chemical control is essential to maintain a sufficient cyanide concentration to keep cadmium in solution and to determine effective anode area. Ball-form anodes in iron wire cages are economical and facilitate control.

C. A., **27**, 3883 (1933). ALLEN S. SMITH.

Electroplating.—U. S. patent No. 1,910,145, May 23, 1933. WM. E. BELKE. In electroplating, such as chromium-plating, the articles to be plated are subjected to centrifugal force sufficient to maintain them in firm contact with a cathode (in a described apparatus) while keeping the plating soln. in ring form in the zone occupied by the articles, with the cathode forming the periphery of the ring, and with an upwardly and downwardly tapering space above and below the ring.

C. A., **27**, 3885 (1933).

Electroplating with aluminum.—U. S. patent No. 1,911,122, May 23, 1933. DONALD B. KEYES, THOMAS E. PHIPPS and WALTER KLABUNDE (to Ellis-Foster Co.). An electrolyte is used containing tetra-ethyl-ammonium-bromide and aluminum bromide, and a voltage is used of 22.6 with a c. d. of 0.068 amp./sq. cm. (63 amp./sq. ft.) of cathode surface. The process is suitable for plating steel economiser tubes etc.

C. A., **27**, 3885 (1933).

Plating metals.—French patent No. 743,797, April 6, 1933. The City Auto Stamping Co. A thick layer of a covering metal or metals is deposited electrolytically on the surface of an unpolished metal so as to cover the defects, and a final brilliant layer is deposited on the intermediate metal or metals. The first deposit may be copper and tin, containing 3 - 30% tin and obtained by electrolysis of a soln. containing copper cyanide, sodium stannate, sodium cyanide and sodium hydroxide. The second deposit may be chromium.

C. A., **27**, 3885 (1933).

Plating of metals with tungsten or molybdenum bronzes.—Hungarian patent No. 104,907, January 16, 1933. Egyesült Izzólámpa és Villamossági R. T. The metals to be plated are made cathodes in solns. of meta- or poly-tunstic or of molybdic salts, e. g., $BaW_4O_{13}.9H_2O$.

C. A., **27**, 3885 (1933).

Electrolytic recovery of lead from waste materials such as battery scrap.—U. S. patent No. 1,911,604, May 30, 1933. JOHN H. CALBECK.

The material is treated in a soln. capable of dissolving lead compounds and including sodium acetate, and the resulting soln. is electrolysed between insoluble electrodes for recovery of lead. An arrangement of apparatus is described.

C. A., **27**, 3885 (1933).

Pickling metals.—French patent No. 743,767, April 6, 1933. Soc. des Produits et Appareils Ménagers and JECHIEL FISZ. Metals are pickled electrolytically in a soln. containing tri-sodium phosphate or tri-potassium phosphate. The electric current decomposes the phosphate to form at the cathodes sodium or potassium which, in contact with water, forms sodium hydroxide or potassium hydroxide and hydrogen. The sodium hydroxide saponifies the fatty materials and emulsifies the mineral oils or insaponifiable fatty materials, while the hydrogen is reduced and detaches oxides from the surface of the cathodes and favors the emulsification of the oils.

C. A., **27**, 3885 (1933).

Pickling iron or steel articles.—Austrian patent No. 133,216, May 10, 1933. OSKAR UNGERSBÖCK and KARL MASCHEK. The article is immersed in a pickling bath through which an electric current is passed, neither electrode being in contact with the article. The direction of current flow may be reversed from time to time.

C. A., **27**, 3886 (1933).

ABSTRACTS FROM THE EDUCATIONAL COMMITTEE

MR. T. F. SLATTERY, Chairman

The causes and prevention of pitting in electrodeposited nickel —
D. J. MacNaughton and A. W. Hothersall
Trans. of the Faraday Society - Vol. 24-page 497 - 1928

The occurrence of pitting in thin deposits of nickel diminishes the decorative and protective value of the coating. In thick deposits, the mechanical properties are impaired thereby.

Pits are defined as "small crater like depressions" in the deposit. They may or may not be pores, that is, pitting and porosity are not the same. Pitting results from a screening effect on the cathode surface, due chiefly to bubbles of hydrogen, though solid particles, or bubbles of air or of oxygen may also have such an effect. Though high acidity of the plating bath favors hydrogen discharge and may favor the electrical attraction of bubbles to the cathode surface, no conclusive evidence connecting it with pitting has been established. There are other factors affecting the over voltage of hydrogen and the adhesion of hydrogen bubbles, such as impurities in the plating solution, the nature of the cathode surface, or capillary forces at the cathode caused by colloidal matter, grease, or oil, to be considered. The relation between pitting and surface defects in the basis metal are studied here.

Circular pits and tailed pits were observed, usually with bright interior surfaces. Other types, as annular or conical, are less frequent. Similar pits occur

in deposits of iron, cobalt, and zinc. Pits in copper are rare. Such pits are sometimes irregularly distributed, sometimes they occur in rows.

Observing the magnified image of parts of the cathode surface during deposition from purified solutions with pure nickel anodes, pits were noted where bubbles clung to the cathode surface or where a succession of bubbles rose from a particular point. The tails of pits are caused by the interference of the bubbles with the free rise of the cathode film of depleted electrolyte. An artificial screen made from a glass rod, produced pits of similar appearance. This screening diminishes the current density and causes local stagnation of the electrotype.

The use of pure materials in plating reduces the amount of pitting. Such pitting as then occurs appears related to defects in the basis metal. On specimen of mild steel, brass and copper, pitting on defective areas was observed during deposition from a carefully purified and regulated bath.

On ground and polished copper, however, no bubbles were evolved and no pits whatever were observed. This was also true of rolled copper sheets given preliminary deposit of copper from an acid copper bath.

Cold rolled mild steel was then coated with copper, either from a cyanide bath, or better, from an acid copper bath over a preliminary thin coating of nickel. A copper deposit of 0.0003 inches was found sufficient to remove the effect of surface defects, and thus to eliminate pitting under favored conditions. Also the cathode efficiency of the nickel increased from 98% on the steel surface to 99.1% on the coppered surface. This beneficial effect is attributable to the high hydrogen overvoltage of copper. That no bubbles were observed during deposition on the copper surface is probably due to the solution of the hydrogen in the electrolyte.

With commercial salts and anodes, pits may occur even after this copper treatment. Such pitting is designated as "solution pitting", as distinguished from "basis metal pitting."

This use of intermediate coating of copper has been previously studied and recommended as a means of reducing porosity and thus increasing the resistance to corrosion. The beneficial effect in reducing pitting does not seem to have been recognized however.

The nature of the factors operating to produce "solution pitting" will be considered in a later paper.

The Electrodeposition of Zinc - P. Rontgen and R. Buchkremer

The Metallurgist (Supplement to the Engineer, London)
June, 1933, page 38

The effect of impurities on the current density, the physical condition, and the chemical constitution of deposits obtained in the electro-refining of zinc were studied. Tables of potential measurements and pictures of deposits are given. It was found that copper deposits with the zinc at low concentration. At higher concentrations, the deposit becomes spongy. Cobalt has a similar effect.

Nickel has little effect at low current density, but causes corrosion at high current density. Arsenic causes nodular growths, as does antimony, as well as a tendency toward corrosion. Cadmium also causes nodules. Iron de-

posits only from a high contentration. Its presence in the bath decreases the cathode efficiency through alternate reduction and oxidation.

The prevention of Injurious Effect of Antimony in Electrodeposition of Zinc and Copper - N. Kameyama and H. Iida - Jour. of the Society of Chem. Industry, Japan. April, 1933, page 1746.

The addition of potassium acid tartrate to copper refining baths greatly retards the deposition of antimony. Thus, its addition to the amount of twenty times the equivalent of the antimony present in a copper bath containing 110 g/l $H_2S.O_4$ + 35 g/l Cu as Cu SO_4 + 0.1 to 0.? g/l Sb, reduced the antimony content of the deposit from 0.0021% to 0.0001%. No appreciable benefit was noted from its addition to an acid zinc bath containing antimony as an impurity.

The Electrodeposition of Palladium - R. H. Atkinson and A. R. Raper
The Metal Industry (London) June 9, 1933, page 38

Palladium has been available commercially since 1919, but good deposits have been made only in the past few years. Complex salts of the nitrite and ammine type are used. Simple salts and the complex halides and cyanides are not satisfactory.

The use of a porous diaphragm, separating the catholyte from the anolyte is recommended. With insoluble anodes, the salt is added to the catholyte and portions of the anolyte are removed periodically. 90% to 95% cathode efficiency with good throwing power can be obtained in this way.

A process using a soluble anode is described. The electrolyte is 10 g/l $Na_2Pd(NO_2)_4$ + 30 g/e Nacl, or a similar bath. Hard rolled sheet palladium is used as anode. The current density is 0.1 amperes per dm_2, used at 40° to 50°C all precious metals and many base metals and alloys can be plated direct. Iron and steel require a preliminary coating of cyanide copper or silver. Bright deposits to 0.001″ are obtainable. Thicker deposits tend to crack. The preparation of the electrolyte and the cell arrangement are discussed in detail.

The corrosion resistance of the deposit is limited by its porosity, as with nickel. Its chief value arises from its non-tarnishing property and from its chemical resistance. Having a better appearance than chromium, its use on jewelry is suggested. It has been used on metal reflectors with success. The deposit can be stripped anodically from a silver base in a solution containing 100 g/l NaCl + 3.6 g/l-HCl.

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BRANCH NEWS

DETROIT BRANCH

Detroit is the Convention City for 1934 and "Believe it or not", as Ripley says, the convention will be a good one. It will be the third for the Detroit Branch and it will be our endeavor to make it the best ever. Everything possible will be done to make it of interest to all members of the A. E. S. The Registration fee will be kept at minimum. The depression has passed. We are again going for reconstruction and see no reason for not being optimistic in having as large an attendance as there was at the last convention held here.

The Detroit Branch held its regular meeting at Hotel Statler on Friday, September 8th, 1933 at 8.30 P. M. with Col. Hansjosten in the chair. The meeting was well attended and decidedly interesting.

Mr. Charles Marker resigned as secretary-treasurer and T. C. Echstaedt was elected to fill the vacancy. Mr. Echstaedt will make every endeavor to give to the Society his best service and will have the full cooperation of the members to bring its financial standing up to par again with fewer suspensions.

As this was the first meeting since June, the Educational Committee were without a program but an interesting verbal report of the Chicago Convention delegates, Col. Hansjosten, Mr. Wilson, Mr. Spencer and Mr. Echstaedt.

A committee on Date and Location for the Convention was appointed comprising Messrs. Spencer, McCord, Lovering, Mankervis and Beaubien. A report is expected at our October meeting.

Mr. Hammond was elected to fill a vacancy on the Board of Managers caused by the resignation of Mr. Echstaedt to accept the office of secretary-treasurer.

T. C. ECHSTAEDT, *Sec'y.*

CHICAGO BRANCH

The Chicago Branch held its regular monthly meeting September 9, at the Atlantic Hotel. Vice President F. Herbst presiding and all other officers present except our President E. G. Stenberg.

Letters of condolence to Mrs. F. J. Liscomb, and to Mrs. F. L. Greenwald, read and ordered spread upon the minutes. A motion was made by Mr. Gilbertson that when a member of Chicago Branch died that all other members of the Branch be notified by the Secretary.

A letter and code for the plating industry sponsored by the Los Angeles branch read and ordered tabled as this society was organized for educational purposes only. The letter and code was referred to Job Shop Owners and Employers.

The meeting was then turned over to our librarian who found the following questions in the question box:

No. 1. *How many years can a plater work around a cyanide solution before it kills him?*

Ans. This brought out a lot of discussion on conditions and ventilation.

No. 2. *Is the use of Hydrogenated Oil in buffing compounds and emery*

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cake detrimental in all cases? When and Why?

Ans. Hydrogenated Oil is used in the place of Steric Acid as a cheap substitute. But one member brought out the interesting fact that while his firm saved $1.00 on the emery cake it wasted $5.00 on the amount of emery cake used and in cleaning labor. Even at that the job when finished was not as satisfactory as when a good compound was used.

A very interesting bulletin was read by O. E. Servis on Chromium Plating with the fluoride Ion bath by A. Perlenfein and Oscar can be sure the members appreciate this valuable information and many of them will start trying out the formula.

J. W. HANLON, *Secretary.*

BRIDGEPORT BRANCH

The Regular Meeting of the Bridgeport Branch was held on September 1 in the Chamber of Commerce Rooms in the Stratfield Hotel.

Pres. Al. Rosenthal called the meeting to order.

The Sick Committee had no report, nor were there any communications nor applications for membership.

The Speakers Committee, Roy O'Conner, George Knecht, and Tom Chamberlain are planning to make the meetings just as successful this year as in previous years by having some of the more prominent men of the Plating line giving us lectures.

A motion was made and seconded that the bill for the Per Capita Tax be signed and paid.

Al Rosenthal, Chairman of the Outing Committee and his assistants, Ben Kusterer, Bill Stratton and Eugene Phillips reported they were making great headway for the Annual Outing September 23. A large crowd of members and their wives are expected to attend. The Treasurer's report was read and accepted and the meeting adjourned at 10 P. M.

WM. FLAHERTY, *Sec'y-Treas.*

LOS ANGELES BRANCH

The regular meeting of the Los Angeles Branch was held at the Rosslyn Hotel, August 9th, 1933.

President M. D. Rynkofs presided.

Financial report and minutes of the previous meeting were read and accepted.

Mr. Coombes, our delegate to the Chicago convention, made his report which was enthusiastically accepted.

The meeting was then turned over to Mr. Hurd who acted as librarian in the absence of Ray Vasquez. The following question was found in the box:

Q. Does a brown scum on chrome plating that can be washed off with a brush but not rinsed off, indicate a lack of sulphate?

A. Not necessarily. Solution may be too cold or need stirring up or it may contain too much tri-valent chromium.

The report of the exposure tests by the Bureau of Standards was read to the meeting.

Mr. Geo. Kyle gave us a talk on the N. R. A.

Meeting adjourned.

EARL COFFIN, *Sec.-Treas.*

When young "Rudy" Hazucha started to work in a plating shop twenty-six years ago, the mysteries and the magic of the queer-smelling solutions, the electrodes and all the rest of it caught his curiosity, and he had to find out what it was all about. So well did he learn his lesson that in six years he was at the head of a department, and for ten years more he had charge of plating and finishing work in some of the largest metal-working plants of the

country, constantly adding to his fund of knowledge and his acquaintance with the craft. Then he went into the sale of lacquers and other metal finishes, where his understanding of the requirements and ability to give quick, unerring service made him at once successful.

His new title: R. J. Hazucha, Chicago District Manager of Ault and Wiborg Corporation, of Cincinnati and New York, a concern with a history of more than fifty-five years of progressive development, evidences a connection which will enable him to extend still further his helpful contacts with the Metal finishing industry. The corporation, one of the earliest in the lacquer field, has a complete and well-seasoned line of Clear and pigmented products for hardware, silverware, lighting fixtures, name plates, refrigerators, caskets and casket hardware and all other branches of the industry, and it makes a specialty of developing new finishes to meet unusual requirements. Stocks are carried in Chicago, New York and other strategic points so that prompt delivery may be made in all parts of the country. Mr. Hazucha has been receiving numerous congratulations on the auspicious opening of his new work, which already is bearing good fruit.

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SUSPENSIONS:

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K. A. Dockstader	Rochester
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